Climate and Ecosystem Dynamic

Part 1 - Sustainability of Ecosystems

What Is Ecology? (1.1 / 1.2 / 1.3)

- **Ecology** is the study of how organisms interact with each other
- Ecological studies can begin at the level of a single organism.
- Investigations are designed to determine how the individual interacts with its environment, and how factors in the environment affect its growth, feeding habits and reproduction.

Abiotic and Biotic Factors

- Non-living Factors or influences on organisms such as amount of sunlight, temperature and strength of wind are called **abiotic factors**.
- Factors caused by the presence and roles of other living things are called **biotic factors.**

Populations

- Organisms usually group with others of the same species. All of the members of the same species, living in the same habitat at the same time are referred to as a **population**.
- Recognise that there are 3 criteria required for a population:
  1. Same species
  2. Same habitat
  3. Same time

Community

- On the other hand, the collections of all the populations of all the species in a particular area is called a **community.**

Ecosystems

- There are many types of relationships among the many species living in an environment (biotic) and the relationships among these organisms and the non-living (abiotic) components of an environment.
- These living and non-living components of a biological community and their interrelationships form an **ecosystem**

Sustainability

- Although there are many advantages of new technology and advancements to humankind, we have also created many problems such as pollution and degradation of ecosystems.
- **Sustainability** is the ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs.

Definitions

- **Food Chain** – is a step-by-step sequence linking the different organisms in an ecosystem that feed on each other, starting with the producer and continuing with consumers
- **Producers –** Are the only organisms in an ecosystem that can make or produce its own food
- **Consumers –** Are organisms in an ecosystem that feed on other organisms to get their energy.

More Definitions

- **Detritus –** a food chain that deals with decomposers
- **Carnivore –** eats animal material (ex. Wolf)
- **Herbivore –** eats plant material (ex. Deer)
- **Omnivore –** eats both plant and animal material (ex. Humans, bears)

Even More Definitions!

- **Decomposers-** these organisms feed on *dead* or decaying matter
- **Habitat –** the conditions required for the survival of a species

Extinction In The Modern World

- Humans and the rate of extinction
  - As the human population increases, extinction increased
  - See Figure 2 on page 16 in your text
  - This is because of:
    - Deforestation
    - Pollution
    - Foreign Species

History of Extinction

- By examining rocks and fossils it has been revealed that several large-scale disasters on Earth have resulted in the extinction of many species
- The largest extinction occurred nearly 245 million years ago in which approximately 80% of species went extinct.
- Scientists believe mass extinctions like that one were caused by asteroids crashing into Earth creating dust that blocked the light from the Sun, set off volcanic eruptions and changed Earth's environmental conditions.

Other Causes of Extinction

- Climate changes
- Pressure of competition
  - If a new species enters into an area and eats the same food as another species, the two must compete for the same food source. The species that is better at this will survive.

Effects of Extinction

- The number of species in an ecosystem is described as the biological diversity or **biodiversity** of an ecosystem

http://www.youtube.com/watch?v=hlRysCjXSmc&feature=youtu.be

- Because all organisms in an ecosystem are connected in some way if the biodiversity is reduced (i.e.. the extinction of a species), a "domino effect" can result.
- For example: if a **predator** went extinct, the population of the **prey** would increase.

Restoring Balance

- How can we restore balance to affected ecosystems?
  - Reintroduction of species to an area
  - Place bans on hunting/trapping
  - Place bans on pesticides

Assignment:

Read pages 8-13 in your textbook, P. 13 # 1 - 5

Read pages 14-15, Compete Question #1 - 2 on page 15

Read pages 16-19, complete Questions 1-3 on page 19

What is Biodiversity? (1.11)

- **Biodiversity** is a measure of the number and variety of species in an ecosystem

Classifying Organisms In An Ecosystem

- When we look at organisms in an ecosystem we can classify them on the basis of what they eat (how they get energy)
- Generally we classify organisms into 2 groups: **producers** and **consumers.**

Producers

- Are the only organisms in an ecosystem that can make or produce its own food
- These organisms are known as **autotrophs** (auto – means self and –troph mean food/eat).
- They use abiotic factors to produce food. For example, plants use the sun's energy to make food by the process of **photosynthesis**. Plants are the largest group of producers
- However, some bacteria and protists (algae) are also producers

Consumers

- Are organisms in an ecosystem that feed on other organisms to get their energy.
- Also referred to as **heterotrophs** (hetero – means other). For example, a deer eats grass to get its energy because it cannot make its own food.
- There are 3 types of consumers.
  - **Carnivore –** eats animal material (ex. Wolf)
  - **Herbivore –** eats plant material (ex. Deer)
  - **Omnivore –** eats both plant and animal material (ex. Humans, bears)

More About Consumers!

- Consumers also come in varying degrees:
  - A **primary** consumer feeds on producers (it is 1st to eat/consume)
  - A **secondary** consumer feeds on primary consumers (2nd to eat/consume)
  - A **tertiary** consumer feeds on secondary consumers (3rd to eat/consumer
  - And so on and so on...

Food Chains!

- A **food chain** is a step-by-step sequence linking the different organisms in an ecosystem that feed on each other, starting with the producer and continuing with consumers
- It shows the flow of energy from one organism to the other so we always draw arrows pointing to the organism that is receiving the food energy (doing the eating)
- NOTE: Food chains **only** include *biotic* organisms
- **Decomposers –** these organisms feed on *dead* or decaying matter. They occur in many spots along a food chain

Example Food Chain

- Grass (producer)
- Grasshopper (1st consumer)
- Bird (2nd consumer)
- Coyote (3rd consumer)
- How does this turn into a food chain?
- Can you think of other examples?
- Want more practice? Check out these fun games!
- http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/index.cfm
- http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm

Trophic Levels in a Food Chain

- Within an ecosystem organisms may also be classified or grouped on the basis of a **trophic level**, which is the position of an organism in the energy flow pyramid of an ecosystem
- In other words, a trophic level states the position of an organism in a food chain
- For example, plants are *in trophic level 1* because they are the first biotic organism in a food chain. If a deer eats that plant it would be considered in *trophic level 2* and so on and so on.

Example Trophic Level Diagram

Trophic Level	Category of Organism	Example of Organism
1	Producer	Grass
2	Primary Consumer; herbivore	Grasshopper
3	Secondary Consumer; carnivore	Snake
4	Tertiary Carnivore; carnivore	Hawk

Can you make your own?

Food Chains and Food Webs

- There are two types of food chains:
  - **Grazer Food Chain** - goes in sequence of a producer → herbivore → carnivore – top carnivore NOTE: a **top carnivore** is the final carnivore in a food chain. It is not eaten by other animals (at least when its alive)
  - **Detritus** – a food chain that deals with decomposers

- In reality most organisms do not eat just *one* thing
- Each individual organism in an ecosystem is involved in <u>many</u> food chains. They all interlock with each other to form a feeding relationship called a **food web**.
- In a basic food chain, we only show producers, herbivores and carnivores. In a *food web* we can show omnivores because we can show that an organism eats plants <u>and</u> animals!

- The most stable ecosystems, those with the greatest *biodiversity*, have such complex and well-developed food webs that the reduction in numbers or even the complete removal of one type of organism may only have a small effect on the overall web
- For example, if one type of plant gets eaten by an insect, the other organisms that normally eat that plant can switch to something else.

- *However*, where abiotic factors limit the number of organisms, the webs begin to look more like food chains
- For example, in the Arctic, there are few producers because of less sun energy and cold temperatures. Here there are limited numbers of organisms and the loss of any one number will have a profound effect on all the remaining organisms
- The *lower* the biodiversity of an ecosystem, the *simpler* the food web and the more *vulnerable* each organism is. This is why we <u>NEED</u> sustainability if we want to meet the needs of future generations!

Energy in Ecosystems

- The source of energy for all ecosystems is the sun. It lights and warms the surface of our planet.
- Of the energy that penetrates into the lower atmosphere, 30% is reflected by clouds or the earths surface.
- The remaining 70% warms the surface of the planet, causing water to evaporate, and generating the water cycle and weather.

EXAMPLE

- **Photosynthesis** is the process by which green plants use sunlight energy to produce carbohydrates (sugars)

- **Albedo Effect**: when sunlight strikes an object some of the energy is absorbed, and some is reflected. Some materials reflect sunlight better than others.
- **Albedo:** is a measurement of the percentage of light that an object reflects.

EXAMPLE

- For the earth, the higher its overall albedo, the less energy will be absorbed and available for maintaining the global temperature
- Snow has a high albedo
- Snow contributes to the low temperatures of winter by reflecting energy from the sun back into space.

- Other light colored areas of the earth's surface like sand, pale rocks, and areas without forest have a similar effect.
- Cloud cover also increases the albedo of the earth. More water vapor or dust = more clouds = more sunlight reflected back into space

Graphing Energy in Ecosystems: Ecological Pyramids

- Graphs called pyramids can be used to represent energy flow in food chains and food webs or the populations of organisms in a food chain

Pyramid of Energy

- It is possible to measure the amount of energy available at each trophic level
- Creating a pyramid graph allows us to understand the relationships and energy flow better
- **Pyramid of Energy**: indicates the total amount of energy in each trophic level and shows clearly the energy transfer from one level to the next.

EXAMPLE

- The larger mass of the individual tertiary (3°) consumers and the vast amount of energy that they spend while hunting limits the number of individuals that can be supported at the top position

Pyramid of Numbers

- **Pyramid of Numbers**: shows the number of organisms in each trophic level
- A pyramid can be drawn counting the number of organisms at each trophic level in an ecosystem
- When the volume of each level (representing the number of organisms at that level) is graphed, it can sometimes generally look like a pyramid

EXAMPLE

- However, ecologists have found that there are many exception because of the physical size of members of a food chain.
- For example, many tiny aphids (an insect that feeds on the sap of plants) may be found feeding off a single plant.

EXAMPLE

Pyramid of Biomass

- Pyramid of Biomass: indicates the total dry mass of each trophic level
- To make such a pyramid, the dry mass (after water has been removed) of the dry tissue of plants or animals is measured and graphed. It is usually a regular pyramid.

EXAMPLE

Implications of Pyramids

- Regardless of the type of pyramid used to illustrate a food chain or web, the end result is the same

1. The energy available to maintain a food chain inevitably runs out unless the original energy, sunlight is continuously fed into the system
2. There is a limit to how much energy is available
3. Primary consumers have access to the most energy

Limits of Energy Transfer

- Producers use energy from sunlight and basic nutrients to make molecules of glucose (sugar)
- Sugar molecules contain the chemical energy needed to drive ecosystems
- Photosynthesis provides the energy required by the entire ecosystem
- Solar energy must be converted into chemical energy before it can be used by living things

Transformation of Energy

- Every time energy is transferred within an ecosystem, some of the energy changes form
- Photosynthesis converts solar energy into chemical energy, and animals rely on chemical energy, food produced by plants
- Not all chemical energy (food) that a plant creates can reach the animal that eats it
- Once an animal takes chemical energy from a plant, it doesn't store it all. Most of the energy is used to move limbs, etc.
- Once the energy has been used, it cannot be transferred

Thermodynamics

- **Thermodynamics**: is the study of energy transformations
- **First Law of Thermodynamics**: although energy can be transformed from one form to another, it cannot be created or destroyed
- **Second Law of Thermodynamics**: during any energy transformation, some of the energy is converted into an unusable form, mostly thermal (heat) energy that cannot be passed on.

- What does this mean in terms of food chains and webs?
- Only about 16.2% of the energy available in a plant is transferred to the primary consumer because most of the energy of the plant is used for:
  1. Staying alive
  2. Growth
- If a deer eats a plant, only 10% of the energy of the plant that was transferred to the deer becomes available to the wolf (that wants to eat the deer) because the other 90% of the energy is used for the process within the deer (digestion, elimination, waste heat)
- In general, the overall loss of energy at each set sets a limit on the number of trophic levels in a food chain at about five

Energy in Ecosystems

- Read pages 32-39 in your textbook complete hand-out

P. 39 # 1 - 14

Populations (2.9 / 2.10)

- A **population** changes with time according to:
  - Natality (birth rate)
  - Mortality (death rate)
  - Immigration (moving in)
  - Emigration (moving out)
- Extremely fast growth of a population is called a **population explosion**. It may be caused by:
  - Introduced species (a new species is introduced to the ecosystem)
  - A plentiful food supply
  - A lack of predators
  - Abundant space available

- **Population extinction** occurs when a greater number of species leave a population than enter it. For example, if mortality, for whatever reason, is higher than natality, low population numbers can lead to inappropriate mating practices, during which harmful gene combinations may occur, causing genetic weakness and further decline in population

- 4 Factors that affect the **carrying capacity** are:
  1. *Materials and energy* – energy from the sun, water, carbon, oxygen and other essential nutrients
  2. *Food chains* – food supply, predator/prey relationships, plant populations etc
  3. *Competition* – demand for resources There are two types of competition:
     a) ***INTRA****specific competition* – competition among members of the same species. (Example: two elk fighting over a mate)
     b) ***INTER****specific competition* – competition among members of different species (Example: wolves vs. coyotes for food supply)

4. Density – depends on the size of the environment, way of life (needs) and population numbers. Also, a species can have different needs for space

- **Population density** means how many individuals can live in an area at one time. Population density can be divided into two different factors
  - Density-**DEPENDENT** factors
    - Food supply
    - Territory
    - Disease (communicable)
  - Density-**INDEPENDENT** factors
    - Fire
    - Flood
    - Weather/Climate

Assignment!

- Read pages 74-79 in your textbook
- do questions 1-7 on page 76.
- Do questions 1 – 5 p. 80

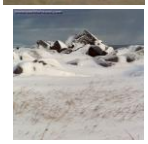
Canadian Biomes (3.1 / 3.2)

- Biome- collection of ecosystems that have a similar climate and major vegetation.

- Canada has 4 major biomes.

Tundra

- Lots of water is held in the layer of soil above the permafrost.
- Slow cycling of matter due to the cold.
- Limited plant life limits the number of consumer



Boreal Forest

- South of Tundra
- Makes up 80% of Forest area in Canada.
- Mainly coniferous trees because of short growing season and acidic soil.
- Branches and needles create constant shade on forest floor.
  - Limited food supply on forest floor

Temperate Deciduous Forest

- South of Boreal Forest.
- Richer soil due to higher temperature.
  - More decomposition of fallen leaves.
  - Sun reaches forest floor.
  - Ideal environment for insects, reptiles, amphibians, mammals, etc.

Grassland

- South of Boreal Forest, same latitude as Deciduous Forest.
- Same abiotic conditions as the deciduous forest except for moisture.
  - Lots of fires prevent large tree growth.
- Black earth of the grasslands is the most fertile soil on earth.
- Low biodiversity because of the openness.

Biogeography

- Different plants grow in different parts of the world due to the climate
  - Usually abiotic factors

- Types of plants grow according to their latitude and altitude.
- The further away from the equator you move, the air becomes cooler and the growing season becomes shorter.
  - Broad-leafed evergreen trees near the equator
  - Thin needled evergreen trees far from the equator.

- The higher up in altitude you move, the cooler the air temperature and less air there is.
  - Larger trees at low altitude.
  - Smaller trees at higher altitude.

Read pages 88 – 96
page 93 # 1 – 9
page 94 – 96 a - p

Part Three

Cycles, Change and Stability in Ecosystems

Cycling of Matter in Ecosystems (2.1)

- **Organic** substances always contain atoms of carbon and hydrogen, and often contain oxygen and nitrogen atoms. Proteins, sugars and fats, the important chemicals that make up your body, are all organic
- Matter that doesn't contain a combination of carbon and hydrogen atoms is called **inorganic.** For example, water (H_2O) and ammonia (NH_3) are considered inorganic.

- The materials used in building the bodies of living organisms are limited to the atoms and molecules that make up the planet. There is ***NO*** alternative source of matter. Therefore, to maintain life on Earth, matter must be *recycled*.
- All atoms on earth are recycled between living (biotic) organisms and the non-living (abiotic) Earth. Even though it sounds crazy, this could mean that the carbon atoms in your body right now could have come from a T-rex that lived million of years ago!

- Food is *organic* matter. Every time you eat, through the process of *digestion*, the complex organic molecules from your food are broken down into simpler molecules. Your cells used these simple molecules to build complex molecules, which become part of your own structure.

- The process of moving these molecules from your living body to the abiotic environment is through decay. After death, decomposers break down the organic matter in dead bodies and feces into small, inorganic molecules (like individual molecules of carbon, hydrogen, oxygen and nitrogen).
- These small molecules pass into the soil or water, where they can become part of the biotic world again at some future time (when plants take up these nutrients in their roots)

The Water Cycle (13.8)

- Is the only way that Earth can be continually supplied with fresh water.
- The heat from the sun is the most important part of this cycle.
- This heat soaks up water from the oceans, lakes, rivers, trees and plants in a process called **evaporation.**
- As the water mixes with the air it forms water vapor. As the air cools, the water vapor forms clouds. This is called **condensation**

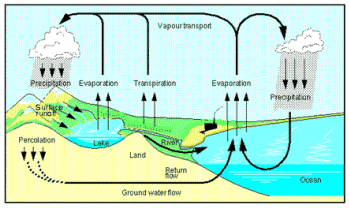
- Most of the water is immediately returned to the seas by rain **(precipitation)**
- The rest of the water vapor is carried inside clouds by wind over land where it rains or snows.
- Rain and melted snow is brought back to the oceans by rivers, streams, and run-off from glaciers and water underground.

Water Cycle: Definitions

- **Evaporation** → In terms of the water cycle, this is referring to when water is continually transforming from liquid to gas due to the Sun's energy
- **Condensation** → In terms of the water cycle, this refers to when, after evaporation, the water vapor strikes cool air and condenses into tiny droplets of water or moisture. These collect upon tiny particles of dirt in the air to form clouds.
- **Precipitation** → In terms of the water cycle, this is when after enough tiny droplets of water or moisture have collected onto dirt or dust in the air, a cloud begins to form. When the cloud becomes heavy enough the water droplets fall to earth as either rain, snow, sleet or hail.

Hydrosphere – All of earths water (solid, liquid and vapor/gas) both fresh and salt

The Water Cycle – SEE BIOLOGY NOTES



Courtesy Erich Roeckner, Max Planck Institute for Meteorology

Assignment!

- Read pages 48-51
- Complete Questions #1-6 on page 51
- Read p. 522 – 524
- Complete questions #1 – 5 on page 524

The Carbon Cycle (2.5)

- Carbon is the key element for living things
- It can be found in the atmosphere and dissolved in oceans as part of the inorganic carbon dioxide (CO_2)
- The movement of carbon, in its many forms, between the biosphere, atmosphere, oceans, and geosphere is described by **the carbon cycle**

- We are all familiar with how the atmosphere and vegetation exchange carbon.
- Plants absorb CO_2 from the atmosphere during **photosynthesi**s and release CO_2 back in to the atmosphere during **respiration.**
- Another major exchange of CO_2 occurs between the oceans and the atmosphere. The dissolved CO_2 in the oceans is used by marine organisms in photosynthesis.

- Two other important processes are **fossil fuel burning** and **changing land use**.
- In **fossil fuel burning**, coal, oil, natural gas, and gasoline are consumed by industry, power plants, and automobiles.
- **Changing land** use is a broad term which encompasses a host of essentially human activities. They include agriculture, deforestation, and reforestation.

The Nitrogen Cycle (2.6)

- Nitrogen is a component of many organic molecules. It forms an essential part of amino acids (which make up proteins) and DNA.
- Nitrogen is essential for all living cells.
- There are huge amounts of nitrogen gas in the atmosphere, but most animals and plants have no way of using it. It needs to be **fixed** (put into a biologically useful compound).
- After it is fixed, it can then start to move through the cycles and organisms in an ecosystem.

- Nitrogen gas is the most abundant element in our atmosphere.
- The other main source of nitrogen is in the nitrates of soil.
- The nitrogen in the atmosphere cannot be used while the nitrates in the soil can be used by plants.
- Nitrogen can be converted into useful **nitrate** compounds by bacteria, algae, and even lightning. Once in the soil, the nitrogen becomes biologically accessible.

- Plants are the main users of nitrogen in the soil. They are able to take in the nitrates through their root system. Once inside the plant, the nitrates are used in organic compound that let the plant survive.
- Then, Herbivores eat plants and convert many of the amino acids into new proteins. Omnivores that eat both plants and animals are able to take in the nitrogen rich compounds as well.
- Nitrogen atoms are returned to the soil in poop and dead organisms. Once in the soil, the whole process can start again!

The Phosphorus Cycle

- Phosphorus is a key element in cell membranes, in molecules that help release chemical energy, in the making of DNA and in the calcium phosphate of bones!
- Phosphorus tends to cycle in two ways: a long term cycle involving the rocks on the Earth's crust and a short term cycle involving living organisms

Phosphorus' Short Cycle

- Phosphorus is found in bedrock in the form of phosphate ions (PO_4^{3-})
- Phosphates are soluble in water and thus can be dissolved out of rocks
- While dissolved these phosphates can be absorbed by photosynthetic organisms and be passed into the food chain!
- The waste from living things are recycled by decomposers, which break down waste and dead tissue to release the phosphates and let the cycle continue…

Phosphorus' Long Cycle

- In the long cycle, the phosphates eroded from the rocks are also carried by water from the land to rivers and eventually to oceans.
- In the ocean phosphates are absorbed by algae and other plants and then enter the food chain
- Animals use phosphates to make bones and shells and when they die these hard remains form deposits on the ocean floor
- These deposits become covered with sediment and eventually become rocks. When the rocks are brought back to the surface the cycle can start again!

Assignment!

- Read P. 62 - 69
- Complete Questions 1-7 on page 65
- P. 69 # 1 - 13

Part 4 – Climate & Weather Dynamic

Introduction (13.1 / 13.2)

Weather - the day-to-day environmental conditions in a location.

Climate - the weather conditions of an area averaged over many years.

Weather Dynamic – the study of how the motion of water and air cause weather patterns

Earths Energy Balance

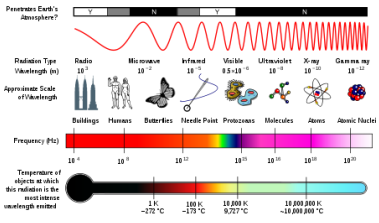
Almost all of the energy used on earth to sustain life and cause our changing weather comes from the sun.

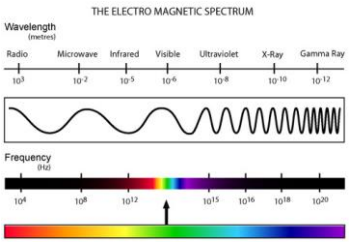
Energy can be transferred from one place to another by four methods:

1. Radiation is the transfer of energy through space by waves.

These waves are called the electromagnetic spectrum

- Radio waves – used to send messages through radio, television, and radar
- Microwaves – used for communication, radar (speeding car), and power (cook food)
- Infrared (IR) – used for medicine (treat skin diseases and relieve the pain of sore muscles). Photographers use IR to take pictures with no light. Burglar alarms. Ovens.
- Visible – Red Orange Yellow Green Blue Violet
- Ultra Violet (UV) - light is found in sunlight
- X-rays are primarily used for diagnostic medicine
- Gamma rays can cause serious damage when absorbed by living tissue, and they are therefore a health hazard.





2. Conduction is the transfer of energy through a substance by the collision of particles.
3. Convection is the vertical transfer of energy by the movement of particles in a fluid (liquid or gas).
4. Advection is the horizontal transfer of energy by the movement of particles in a fluid (liquid or gas).

Heat capacity is a measure of how much energy is required to raise the temperature of a substance.

Heat Sink – any object or material that absorbs energy and becomes warmer.

P. 502 – 503 # 1 – 4, 6 – 9

P. 504 – 507 # 1 – 8

Prevailing Wind Patterns (13.6 / 13.8)

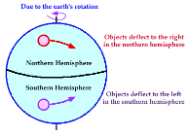
Prevailing winds – winds that effect large areas

Jet Streams – high-speed winds in the upper regions of the troposphere

- A jet stream develops where air masses of differing temperatures meet.

Coriolis Effect – the apparent change of direction of a moving object in a rotating system

- Once air has been set in motion by the pressure gradient force, it undergoes an apparent deflection from its path, as seen by an observer on the earth. This apparent deflection is called the "Coriolis force" and is a result of the earth's rotation.



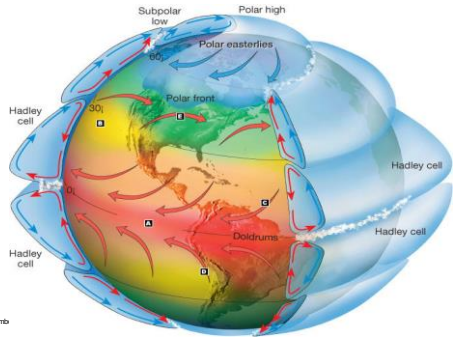
- As air moves from high to low pressure in the northern hemisphere, it is deflected to the right by the Coriolis force. In the southern hemisphere, air moving from high to low pressure is deflected to the left by the Coriolis force.

Air Movement

- **Wind** is the movement of air caused by differences in air pressure
- The **greater** the difference, the **faster** the wind moves

Air Pressure

- Differences in air pressure are caused by the **uneven heating** of Earth
- Uneven heating produces **pressure belts** which occur every 30° latitude



Pressure Belts

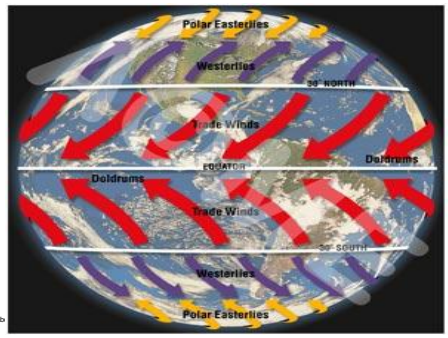
- As **warm air** rises at the equator and moves toward the poles, it cools
- As it cools, some of the air sinks around **30° north and south** of the equator

Pressure Belts

- At the poles, **cold air sinks** and moves towards the equator
- Around **60° north and south**, the air begins to heat up and rise

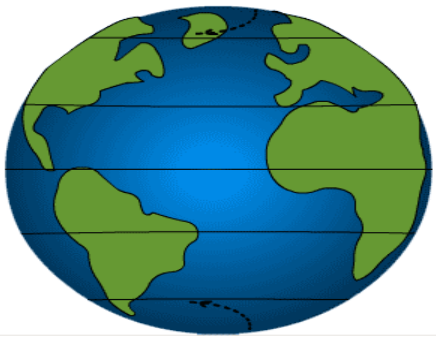
Global Winds

- The combination of pressure belts and the Coriolis Effect cause **global winds**
- These are **polar easterlies, westerlies, and trade winds**



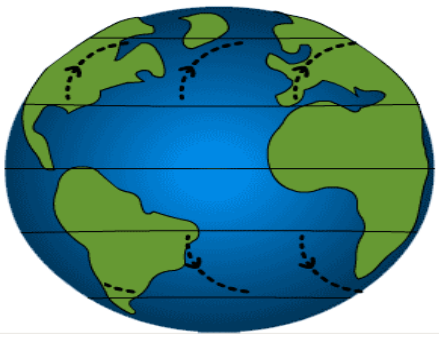
Polar Easterlies

- Wind belts that extend from the **poles to 60° latitude**
- Formed from cold sinking air moving from the poles creating **cold temperatures**



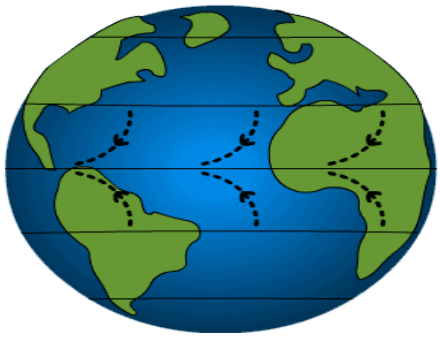
Westerlies

- Wind belts found **between 30° and 60° latitude**
- Flow towards the poles from west to east carrying **moist air** over the Unites States



Trade Winds

- Winds that blow from **30° almost to the equator**
- Called the trade winds because of their use by **early sailors**



Doldrums

- Located along the equator where **no winds blow** because the warm rising air creates and area of low pressure

Horse Latitudes

- Occur at about 30° north and south of the equator where the winds are **very weak**
- Most deserts on the Earth are located here because of the **dry air**

Jet Stream

- The jet streams are narrow belts of **high speed winds** that blow in the upper troposphere and lower stratosphere
- **Separates** warm air from cold air

Local Winds

- Generally move **short distances** and can blow in any direction
- Caused by **geographic features** that produce temperature differences

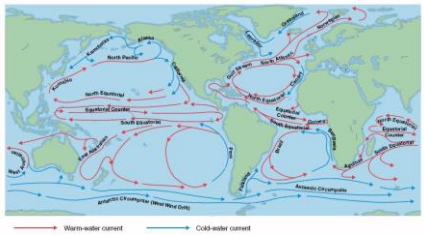
Causes of prevailing winds:
- convection currents (warm air rises)
- earths eastward rotation

Effects of prevailing winds:
- distribute solar energy from the equator to cooler regions
- carry moisture

Major Ocean Currents

Ocean currents distribute warm water and energy from the equator around the world.

Causes of Ocean currents:
- Convection currents
- Wind across the ocean
- Earth's rotation
- Shapes of the continents
- Heat capacity of water
- Salinity of the water (salt content)



Warm water makes warm air that holds more moisture, cold water creates cold air that does not hold much moisture.

Read pages 516 - 519

P. 516 – 519 # 1 – 3 omit b

Read pages 525 - 527

P. 525 – 527 #1 – 7

A Global Weather Model (13.13)

Solar Energy – amount of sunlight

Cloud Cover – clouds help to maintain the energy balance on earth

Earth's Rotation – causes winds to twist to the right in the northern hemisphere

Jet Stream – high speed winds in the upper atmosphere

Prevailing Winds – large scale winds that move warm air from the equator to the poles

Ocean Currents – distribute energy from the equator to the poles and move cold water from the poles to the equatorial regions

Land Masses – heats up and cools down much faster than water and effects cloud formation

Hydrosphere – all of earths water fresh and salt liquid and ice

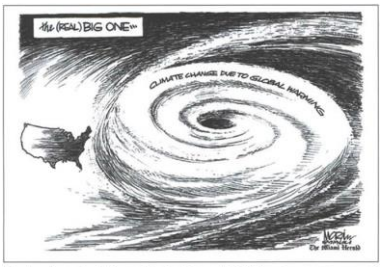
Read pages 536 - 537

P. 536 – 537 # 1 – 8

Part 5 – Climate Change

Global Climate Change (16.1 / 16.2)

Climate change is a change in the "average weather" that a given region experiences. Average weather includes all the features we associate with the weather such as temperature, wind patterns, and precipitation.



Hurricane Ivan—the ninth-named tropical storm of the 2004 hurricane season—spawned a brief resurgence of interest in global warming.

M. The Greenhouse Effect and Ozone Depletion

The Greenhouse Effect is a natural process by which a planet's atmosphere traps thermal energy from the Sun, causing the temperature of the atmosphere to increase.

Greenhouse Gases such as water vapour, carbon dioxide, methane, ozone, nitrous oxides, and chlorofluorocarbons absorb and re-emit infrared radiation in the atmosphere.

Global Warming is the increase in the average Earth's temperature due to an increased concentration of greenhouse gases in the atmosphere that amplifies the Greenhouse Effect.

Ozone, O_3, is a gas that consists of three oxygen atoms.

Smog is a generic term used to describe mixtures of pollutants in the atmosphere.

Read pages 620 - 628

P. 622 – 624 # 1 – 8 ***P. 625 – 628 # 1 - 8***